Do You Know What Your Nonverbal Behavior Communicates?

Do you know what your nonverbal behavior communicates? – Studying a self-reflection module for the Presentation Trainer.

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Abstract. In recent years, research on multimodal sensor-based technologies has produced different prototypes designed to support the development of public skills. These prototypes are able to analyze the nonverbal communication of learners and provide them with feedback, in cases where human feedback is not available. One of these prototypes is called the *Presentation Trainer* (PT). Experts in public speaking claim that ultimately there is not such thing as the right way to do a presentation. They pointed out that it would be useful for tools such as the PT to present learners with the opportunity to become aware of their own nonverbal communication. Following this suggestion we developed a self-reflection module for the PT. In this study we conducted user tests exploring the use of this module. Results from these tests showed that participants perceived that the self-reflection module helped them to reflect about their performance, and point out research paths to further investigate the influence of self-reflection in the learners' performance.

Keywords. Self-reflection, sensor-based learning support, public speaking, multimodal learning application.

1 Introduction

Instead of pledging for mercy after being accused from corrupting the minds of young people, Socrates in his public apology gave one of the most influential speeches of all time with the central message claiming that "the unexamined life is not worth living" [1]. From asking people to examine their life, to influencing a whole country to send a man to the moon [2], public speeches have the power to shape human history. Currently educational researchers, teachers, employers and policy makers consider public speaking as a core competence for educated professionals [3-6] and include it in the list of 21st century skills that help learners to function effectively at work as well as in their leisure time [7-9].

Practice and feedback are key aspects for the development of public speaking skills [10]. Nevertheless, the opportunity for learners to get enough practice and feedback in

current public speaking courses is limited, thus graduates often lack the skills to speak in public [11]. Providing learners with the feedback needed through human assistance is neither a feasible nor a practical solution. Computerized systems with multimodal sensing capabilities have already been used to provide learners with feedback for numerous types of learning applications when human tutors are not available [12]. These learning applications include the development of basic public speaking skills, where several presentation training applications have been developed and tested showing positive results in laboratory[13-16] and classroom conditions [17]. One of these applications is the *Presentation Trainer* (PT), a multimodal tool that allows learners to practice their presentation skills while receiving basic feedback in real-time regarding their nonverbal communication [16]. One limitation of the PT according to experts in the field of public speaking is that the PT provides learners only with corrective feedback when ultimately there are no strict rules for presenting to the public [17]. Therefore, experts suggested to expand the focus of the PT, making it a tool that allows learners to increase their level of awareness and help them to reflect on their performance [18].

To improve the PT, based on the expert evaluation, we developed a self-reflection module for the PT. The purpose of this paper is to report on the user tests conducted to explore the usage and impact of this self-reflection module.

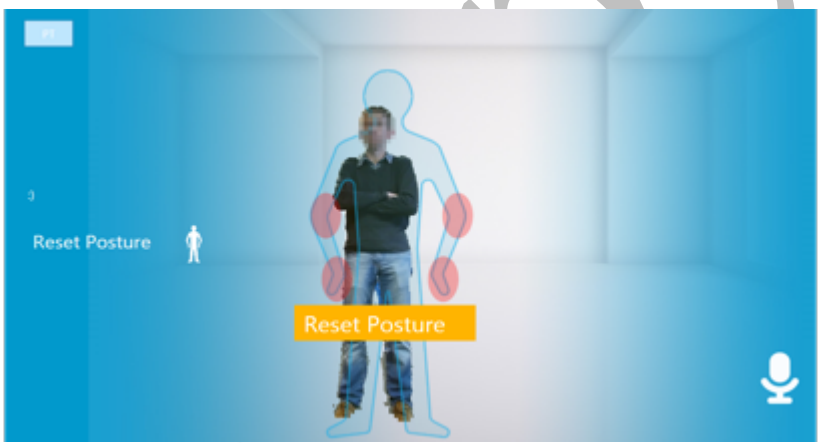

Fig. 1. PT telling the user to correct the posture.

2 Presentation Trainer

The Presentation Trainer is a multimodal tool designed to support the development of basic public speaking skills. It allows learners to practice their presentations while receiving feedback regarding their nonverbal communication. The PT uses the Microsoft Kinect V2 sensor to capture the nonverbal communication of the learner. The learner can practice her speech while standing in front of the Kinect sensor and receiving immediate feedback from the PT. The reason for providing immediate feed-

back to the learner is that for aspects that can be corrected immediately such as the nonverbal communication, immediate feedback has proven to be more effective than delayed feedback [19]. Another important aspect of the PT's feedback is that it provides the learner with a maximum of one corrective feedback instruction at a given time (see Fig. 1). This because the display of multiple feedback instructions at a given time has shown to be too overwhelming for the learner [20]. With the addition of the self-reflection module, a practice session with the PT consists of two phases. In phase one, the learner practices her presentation and receives immediate feedback through the real-time module. All data is captured and aggregated for use in the self-reflection module. In phase two, the learner is guided through the self-reflection module.

2.1 Self-reflection module

The self-reflection module of the PT has the purpose to help learners to increase their awareness regarding their performance while reflecting on it. It consists of six different sub-modules: *Pauses Report, Posture Report, Gesture Report, Overall Performance Report, Future Improvement, and Improvement Text*.

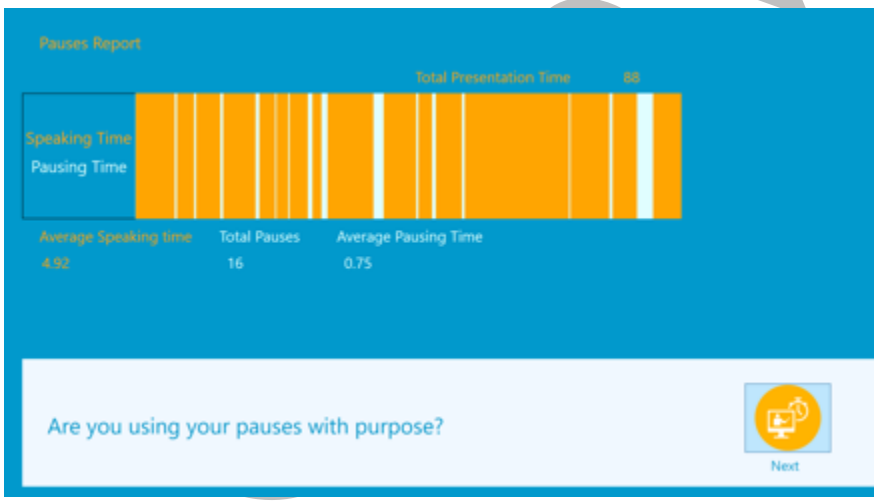

Fig. 2. Pauses Report sub-module.

Pauses Report is designed to help the learner to reflect about her use of pauses during the practice session (see Fig. 2). The first item presented in this report is a timeline that shows the learner her speaking and silent moments that were captured during the practice session. This timeline also shows the total number of pauses, the average pausing time and the average speaking time. The second item of this report asks the learner two questions:

- "Are you using your pauses with purpose?"
- "How can you improve your use of pauses?"

The second question comes up with a text-field allowing the learner to type an answer.

Posture Report (Fig. 3. Left) is designed to help the learner to reflect about her posture during the presentation. The first item displayed in this sub-module is a set of three screenshots captured in the moments that the PT captured a "posture mistake" during the practiced presentation. In case that the PT identified less than three "posture mistakes" during the practice it will show the learner screenshots of random moments from the presentation. The second item in this sub-module asks the learner two questions:

- "The attitude reflected in your posture, is the same attitude that you want to convey?"
- "What would you improve from your posture?"

The second question comes with a text-field allowing the learner to provide an answer.

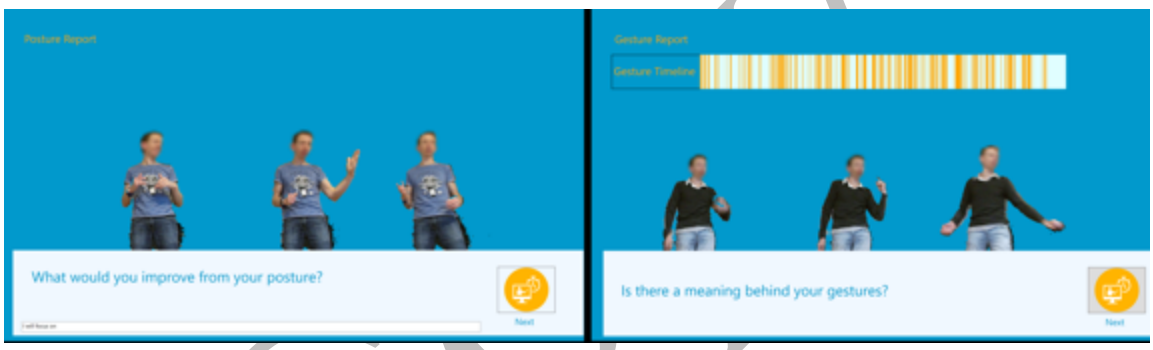

Fig. 3. Left: Posture Report; Right: Gesture Report

Gesture Report (Fig. 3. Right) is designed to help the learner to reflect about her use of gestures. The first item presented in this module shows a timeline that indicates the moments during the practice presentation where gestures were identified. The second item shows three screenshots taken while the learner was using a gesture during her practice. The third item of this sub-module asks the learner two questions:

- "Is there a meaning behind your gestures?"
- "What gestures can you add to support your communication?"

The second question comes with a text-field allowing the learner to type an answer.

*Overall performance Report (*Fig. 4.) presents the learner with a timeline showing all the identified events captured by the PT during the practiced presentation. It shows in red the moments where a "mistake" was identified, in green the moments where a positive behavior was identified (e.g. smiling). It also shows with small icons the moments where the feedback of the PT was displayed.

Fig. 4. Overall performance report showing the events capture by the PT during practice

Future improvement (Fig. 5. Left) asks the learner "what would you like to improve for your future presentation?". This sub-module allows the user to select one of the aspects that can currently be trained using the PT: Posture, Voice Volume, Gestures, Pauses, and Facial expression. If the learner selects Posture, Gestures or Pauses then during the following training session her *Improvement Text* (Fig. 5. Right) will be displayed. The text displayed in the *Improvement Text* corresponds to answer given by the learner to the second question of the corresponding report. For example in the case that the learner selects to improve on her Posture, then the *Improvement Text* displayed during her following training session is the answer she gave to the question "What would you improve from your posture?" from the *Self-reflection Posture Report*.

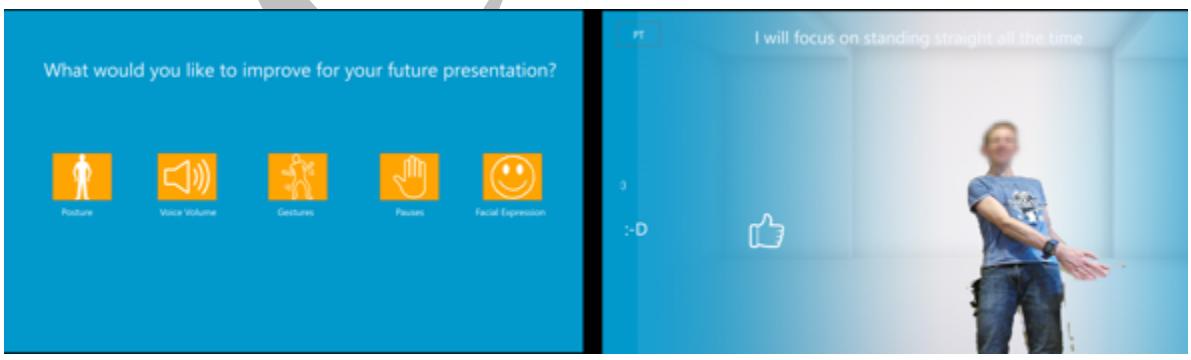

Fig. 5. Left: Future Improvement Screen. Right: Practice session showing Improvement Text on top

3 Method

In this study we conducted user-tests [21] in order to evaluate the self-reflection module of the PT. The objectives for conducting these tests were the following:

Objective 1: Identify perceived difficulty for learners to correctly interpret the different items from the self-reflection module.

Objective 2: Identify whether the different items help learners to become aware and reflect about their performance.

Objective 3: Identify the influence of the Self-Reflection module on the learners' decision to select what to improve for future practice sessions.

Objective 4: Explore the influence of the Self-reflection module in the learners' performance.

3.1 Study Context

We conducted this study in the setting of a course in entrepreneurship for master students in a university. For this course students are divided in teams. During the course each team is required to develop and present an entrepreneurial product or service. Presenting their project effectively is an important aspect of the course, therefore during the course students receive guidance regarding their presentation skills. This study was conducted five weeks after the students had their first public speaking lecture for the course.

3.2 Study procedure

Twelve participants, nine males and three females between the age of 24 and 28 years took part in the study. To prepare for the study, students got the homework to prepare a 60 to 120 seconds long pitch regarding their project. One week later the user-tests were conducted during a two-hour session slot.

For the user-tests participants individually entered into a classroom with the PT. After arriving the experimenter gave the student a brief description of the task and a brief description of the feedback from the PT. Then the student practiced the pitch two times using the PT. After the two practice sessions the student filled in a questionnaire regarding the self-reflection module of the PT.

3.3 Apparatus and Material

The version of the PT that includes the self-reflection module was used as the intervention tool for this study. The log files generated by the PT were used to measure the performance of the participants. The log files included all the events captured during the practice sessions e.g. posture, gesture, volume, phonetic pauses, facial expressions and cadence mistakes. These log files also contained the selections made by the participants for future improvements.

A post-test questionnaire was used to inquire participants about their experience with the PT's self-reflection module. This questionnaire was divided in segments that align with the self-reflection sub-modules of the PT: *Pause report*, *Posture report*, *Gesture report*, *Overall performance report* and *Future improvement*. The items in the questionnaire inquired about the difficulty to interpret the different timelines displayed in the reports, and the perceived usefulness of the elements, i.e. helping learners to become aware of their performance and reflect on how to improve in the future.

During the experimental sessions the experimenter took notes regarding the use of the self-reflection module and performance of the participants.

4 Results

Results from the post-test questionnaire regarding the *Pause report* are displayed in Table 1. The results show that generally the *Pause report* helped participants to reflect about the use of pauses. The element that received the highest rating with a mean score of 4.22 out of 5 turned out to be the question: "Are you using your pauses with purpose?". As an extra remark one participant commented the following: "The timeline make me realize that my usual pauses are too short."

Table 1. Scores from the post-test questionnaire regarding the *Pause report*

Item from the questionnaire	**Mean and standard deviation** (1 totally disagree – 5 totally agree)
The timeline for speaking time and pausing time is easy to interpret.	4.11 (0.93)
The timeline helped me to remember what I did during the presentation	3.33 (1.12)
The question: "Are you using your pauses with purpose?" helped me to reflect about my performance.	4.22 (0.67)
The question "How can you improve your use of pauses?" helped me to think on how to improve my future performances	3.67 (1.41)
Overall the *Pause report* helped me to reflect about my use of pauses	3.89 (0.78)

Table 2 displays the results from the post-test questionnaire regarding the *Posture report.* Overall the *Posture report* helped participants to reflect about their posture. The item that received the best score with a mean of 4.33 out of 5 was the question: "What would you improve from your posture?".

Table 2. Scores from the post-test questionnaire regarding the *Posture report*

Item from the questionnaire	**Mean and standard deviation** (1 totally disagree – 5 totally agree)
The pictures of me giving the presentation helped me to become aware of how my posture is perceived by the audi-	4.22 (0.97)

ence.	
The question: "The attitude reflected in your posture, is the same attitude that you want to convey?" helped me to reflect about my performance.	4.11 (0.93)
The question "What would you improve from your posture?" helped me to think on how to improve my future performances	4.33 (0.71)
Overall the *Posture report* helped me to reflect about my posture.	4.11 (0.78)

Table 3 displays the results from the post-test questionnaire regarding the *Gesture report*. Overall according to the participants the *Gesture report* helped them to reflect about their use of gestures. The screenshots captured of the participants while doing a gesture was the element of the Gesture report that received the highest score with a mean of 4.67 out of 5. As an extra comment one participant suggested to also record some videos for the captured gestures.

Table 3. Scores from the post-test questionnaire regarding the *Gesture report*

Item from the questionnaire	**Mean and standard deviation** (1 totally disagree – 5 totally agree)
The gesture timeline is easy to interpret	3.22 (1.09)
The gesture timeline helped me to become aware of how many gestures I used during my presentation	3.89 (0.78)
The pictures of me using gestures helped me to become aware of how my gestures are perceived by the audience.	4.67 (0.50)
The question: "Is there a meaning behind your gestures?" helped me to reflect about my performance.	4.33 (0.50)
The question "What gestures can you add to support the communication of your message?" helped me to think on how to improve my future performances	3.67 (1.66)
Overall the *Gesture report* helped me to reflect about my use of gestures	4.11 (0.93)

Results from the post-test questionnaire regarding the *Overall performance report and Future improvements* are displayed in Table 4. In summary the *Overall performance report* was perceived as easy to interpret, helpful in terms of reflecting about the overall performance and helpful on reflecting how to improve future performances. One participant commented that it was difficult to connect the problems shown in the timeline with the things done during training. Generally participants liked the idea to be asked by the PT on what skill they want to focus for the following practice sessions. Most of them also considered it a good feature to display on top of the screen what they want to improve during the next practice session. Only one commented that having this extra information is overwhelming.

Table 4. Scores from the post-test questionnaire regarding the *Overall performance report* and *Future Improvements*

Item from the questionnaire	**Mean and standard deviation** (1 totally disagree – 5 totally agree)
The Overall performance report is easy to interpret	4 (0.71)
The Overall performance report helped me to become aware of my performance.	3.89 (1.17)
The Overall performance report helped me to think on how to improve my future performances	3.78 (1.39)
It is a good concept that the PT asks: "What would you like to improve for your future presentation?"	4.33 (1.32)
Seeing my answer on top of the screen of what I want to focus during my presentation is helpful.	3.67 (1.22)
My selection regarding what to improve on a following session was based on (Multiple selections were possible):	Pause report - 6 participants Gesture report – 4 participants Practice Feedback – 2 participants Posture report – 1 participant

We analyzed the performance of the participants for both of the practice sessions using the logged files generated by the PT. In its current version the PT is able to analyze behaviors that are considered mistakes. To evaluate the performance of the participants for each of the practice sessions, we calculated the percentage of time that a mistake was identified during a practice session (pTM). To calculate the pTM we add the duration of all the mistakes captured by the PT during a practice session, and divided this added mistake time by the total duration of the practice session. Table 5. displays the mean and standard deviation pTM values for the first and second practice session in this study. Results show that on average participants during the second practice session improved in all aspects. The aspect that received the worst evaluation for the first session was use of pauses, followed by used of gestures and then voice volume. In the second practice session the use of pauses got the worst assessment, followed by voice volume and use of gestures. The aspect displaying the biggest improvement for both sessions was the use of gestures, followed by the use of pauses.

Table 5. pTM scores captured during the practice sessions (mean and standard deviation).

	Posture pTM	Volume pTM	Pauses pTM	Blank F. pTM	Gestures pTM	Dancing pTM	P. Pauses pTM	Total pTM
1st Session	0.017 (0.05)	0.153 (0.10)	0.290 (0.19)	0.009 (0.21)	0.238 (0.28)	0.000 (0.00)	0.032 (0.02)	**0.739 (0.47)**
2nd Session	0.009 (0.04)	0.133 (0.11)	0.197 (0.22)	0.001 (0.22)	0.082 (0.17)	0.012 (0.02)	0.016 (0.02)	**0.451 (0.33)**
Mean Difference	0.008	0.020	0.093	0.008	0.156	0.012	0.016	**0.313**

We examined the possible effects that the selection to improve a specific behavior had on the performance on this behavior in the following practice session. To do that, we measured the improvement between practice sessions. We grouped the participants who made the same selections. Then we measured the improvement that they had for the selected behavior. We obtained this improvement by measuring the difference of the pTM scores between the first and second practice session for the selected behavior. Finally we compared the mean improvement from the group that selected the specific behavior against the mean improvement from the whole set of participants. Table 6. shows the comparison of the improvements from the groups that selected a specific behavior against the whole set of participants. The results on the table show that participants who selected to focus on the use Pauses, Gestures or Facial expressions between the 1st and 2nd practice session displayed on average a bigger improvement for their selected behavior, than the average improvements for these behaviors taking into account all participants. The exception is Posture, where the performance of the participant who selected to focus on Posture, become worse in terms of Posture during the second practice session.

Table 6. Comparison of the captured improvements grouped by the participants who selected to improve a specific behavior against the whole set of participants.

	Improvement 1st and 2nd practice session for participants who selected to improve the specific behavior	Improvement between 1st and 2nd practice session for all participants
Pauses	0.226	0.093
Posture	-0.021	0.008
Gestures	0.255	0.156
Facial Expressions	0.05	0.008

The experimenter observed that in the first few moments of the second practice session participants did put a lot of effort in improving what they selected to improve. For example usually participants make the first pause once the PT sends the feedback that is time to make a pause, currently this time is set up to 15 seconds of speaking without pausing. From the logs of the presentation trainer is possible to observe that the six participants who selected to improve their use of pauses, made a deliberate pause before the first 15 seconds of the second practice session. After that, their following pauses where made after the PT indicated them to do so. Similar behavior was observed with the participants who selected to improve their gestures. During the first moments of their second practice session they introduced some iconic gestures, later they stopped with the iconic gestures and returned to the usual way of moving their hands while speaking. The same was observed with the participant who wanted to display a "more open posture". The participant started the speak with arms open, palms of hands facing to the front and after few seconds, the participant returned to the ordinary posture.

One final observation happened while the participants were interacting with the self-reflection module. During this interaction four participants commented out-loud

that in order to improve their performance, it would be necessary to modify their pitch and rewrite it based on the information presented by self-reflection module.

5 Discussion

Results from the post-test questionnaire allowed us identify that the different elements of the self-reflection module of the PT were interpreted correctly by participants without major difficulties. Results also indicate that the different elements of the self-reflection module were perceived as helpful in supporting learners to reflect about their performance. These two outcomes satisfactorily address *Objective* 1 and *Objective* 2 of this study. The post-test questionnaire also positively addresses *Objective* 3 of this study. It shows that the self-reflection module substantially influenced the participants' selections on what to focus on future practice sessions.

Objective 4 of this study deals with exploring the influence of the self-reflection module on the learners' performance. To examine this influence we analyzed the logged data of the PT. The analysis of the logged data shows that the participants that selected a specific behavior to improve, had a slightly bigger improvement in this behavior than the participants who did not select it. However, the number of participants and the difference in improvement are both to small. Therefore, we cannot attribute with certainty that the observed improvements are the result of the interaction with the self-reflection module. Similar results were obtained when looking at the general measured improvements (improvements considering all skills, not only the selected ones to be improved). The general improvements captured in this study are also slightly bigger than the improvements observed in a previous study that used a version of the PT without the self-reflection module (0.313 measured in this study in contrast to 0.284 measured in [17]). Nonetheless, the difference in settings between both studies and the minimal difference in improvements does not allow us to assert that the self-reflection module of the PT influenced the participants' performance. Having said that, observations from this study lead us to consider that the slightly bigger improvements can be attributed to the first few moments of the second practice sessions. During these first few moments it was observed that participants deliberately changed their usual communication practices, and that these deliberate changes quickly fade away. This points out a limitation for this study. The set-up of the study did not provide with the necessary methods to systematically measure the possible subtle differences in performance influenced by the self-reflection module. An important limitation is the constrained amount of practice offered. Just one additional practice session is likely too limited.

One of the most interesting findings in this study is that without being asked, four participants out-loud commented the importance of rewriting their pitch based on the information presented by the self-reflection module. Due to time constrains and study design participants were not allowed to do so. However, these comments are clear indications that the module fulfilled its main purpose. It made participants truly reflect on how to improve their performance. These comments made us reconsider our approach on how to study the influence that self-reflection has in the learners' perfor-

mance. In this and previous studies with the PT, the learners' performance was measured through the learners' displayed behavior, cognitive changes were not assessed. Therefore the main influence of the self-reflection module might not merely be displayed as machine-measured improvements in behavior. Rather, the main influence of this module relies on the awareness raised on participants to reconsider and adapt their behavior, for further practice sessions with the PT or even better, in real presentations.

6 Conclusion and Future Work

In resent years the use of multimodal public speaking instructors has been researched, in order to support learners with the practice and feedback needed to develop their public speaking skills. So far studies regarding these instructors have presented promising results showing that learners are able to adapt their behavior based on the feedback provided by these systems. Research has also shown that these changes in behavior also translate to better presentations according to human audiences. Following public speaking experts' suggestions on how to improve these technologies, we added a self-reflection module to the PT and conducted a formative evaluation on it. The module added fits well within theories of reflection [22]. With the added module the PT enables now both reflection-in-action (reflection on behavior as it happens, so as to optimize the immediately following action) and reflection-about-action (reflection after the event, to review, analyze, and evaluate the situation, so as to gain insight for improved practice in future) [23].This evaluation allowed us to draw the following conclusions:

- Learners perceived that the different reports of the self-reflection module helped them to reflect about their performance. These reports confront learners with evidence of events that happened during the practice session (e.g. screen shots, timeline of events), together with questions inquiring whether the presented evidence is aligned with their expectations, and questions asking for means to improve their performance.
- The self-reflection module influences the learners' decision on what they would like to improve on in future practice sessions.
- The self-reflection module does not present a substantial influence in the participants' measured behavior. Likely, only one additional practice is not sufficient.
- The self-reflection module made some participants aware that a new pitch should be rewritten taking in consideration the presented information in order to substantially improve their performance.

To improve the self-reflection module we find it important to continue studying its effect on the learners' performance. This includes systematically exploring the changes in behavior that seem to happen during the first moments of the practice sessions. Closely identifying the changes and timely measuring when they fade. Also provide learners the opportunity to rewrite their pitch or presentation based on their self-reflection, and meticulously study the differences between the old and the newly re-

written pitches. Moreover, equally, important, to investigate the optimal amount of practice sessions. Finally investigate whether the self-reflection module is able to influence the learners' performance, in a way that a human audience is able to recognize.

To finalize, this study instead of providing conclusive evidence on the effects of a self-reflection module for multimodal public speaking coaches, it revealed new paths for future research. Paths that go beyond the exploration of multimodal applications designed to support learners with the automation of their behavior. It revealed paths for investigating how sensor-based public speaking coaches can also support learners with the examination of their performance and making it worth for them.

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